FORM PTO-1390 (REV. 12-2001) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: FORSAL-39

U.S. APPLICATION NO (If known, see 37 CFR 1.5): 10/089800

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FI00/00843	02 October 2000 (2.10.00)	04 October 1999 (4.10.99)

TITLE OF INVENTION: Procedure and Means for Generating Turbulence in Stock Suspension Flow

APPLICANT(S) FOR DO/EO/US: SOINI, Sakari

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [X] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is attached hereto (required only if not communicated by the International Bureau).
   b. [ ] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [ ] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [ ] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [X] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [ ] Other items or information:

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/089800	PCT/FI00/00843	FORSAL-39

21 [X] The following fees are submitted:

	CALCULATIONS PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1)-(5)):	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**	
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**	
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 1040.00
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	20 - 20 =	0	x **$18.00**	$ 0.00
Independent claims	4 - 3 =	1	x **$84.00**	$ 84.00
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$280.00**	$ 0.00
TOTAL OF ABOVE CALCULATIONS =				$ 1,124.00
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.			+	$
SUBTOTAL =				$
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$
TOTAL NATIONAL FEE =				$
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 0.00
TOTAL FEES ENCLOSED =				$ 1,124.00
			Amount to be refunded:	$
			charged:	$

a. [X] A check in the amount of $ 1,124.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 15-0660 A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
David R.J. Stiennon
Lathrop & Clark LLP
740 Regent Street, Suite 400
P.O. Box 1507
Madison, WI 53701-1507
USA

David R.J. Stiennon
SIGNATURE

David R.J. Stiennon
NAME

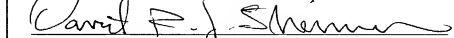
33,212
REGISTRATION NUMBER

In The United States Patent And Trademark Office

Applicant:	Sakari Soini	Date:	April 3, 2002
Date Filed:	Simultaneously herewith	Docket No.:	FORSAL-39
PCT App. No.:	PCT/FI00/00843		

For: Procedure and Means for Generating Turbulence in Stock Suspension Flow

Certificate of Express Mailing
I hereby certify that this document is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 35 C.F.R. §1.10
on April 3, 2002
with Mailing Label No. EV 015 204 447 US
and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.



Signature
David R. J. Stiennon, Reg. No. 33212
Name of applicant, assignee or Registered Representative

Preliminary Amendment

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to examination of the above application, please amend the application as follows.

In the Specification:

Please amend the specification as shown on the accompanying Clean Copy of Substitute Specification. A Marked Up Copy of Substitute Specification is also provided, as well as a Statement as to Lack of New Matter under 37 C.F.R. 1.125(b)(1).

Applicant: Sakari Soini
PCT App. No.: PCT/FI00/00843

In the Claims:

Please cancel claims 1–10 and add the following new claims.

11. A method for generating and maintaining turbulence in a stock suspension flow which is conducted through a turbulence generator into a slice duct of a headbox and therefrom, through a slice opening to a web former, in which procedure the stock suspension flow is distributed into a number of superimposed layers with the aid of turbulence pipes, wherafter an impact of elements generating and maintaining turbulence is directed thereto, wherein the turbulence is generated in different layers of the flow in different phases of the flow by arranging the elements generating and maintaining turbulence at different distances from the slice opening of the headbox, whereby, at the slice opening, a different turbulence prevails in different layers of the stock suspension flow.

12. The method of claim 11, wherein the elements generating and maintaining turbulence comprise stepped expansions of the flow cross-section area of the turbulence pipes, the stepped expansions being positioned in superimposed rows of the turbulence pipes at different distances from the slice opening of the headbox.

13. The method of claim 11 wherein the turbulence pipes have outlet ends through which the stock suspension flow passes into the slice duct, and wherein the elements generating and maintaining turbulence comprise trailing elements on the outlet ends of the turbulence pipes, the trailing elements extending to the slice duct of the headbox, wherein each trailing element has a tip, and wherein the distance of the tips from the slice opening of the headbox is arranged to be different between the superimposed flow layers.

14. The method of claim 11 wherein in the dimensioning of the elements generating and maintaining turbulence, the structure of the web former subsequent to the headbox is taken into account in that in the layers of the stock suspension flow being filtered last in the web former, said elements are positioned closer to the slice opening of the headbox than in the layers of the stock suspension flow which will be filtered first.

15. A turbulence generator for the headbox of a paper machine, the headbox having a width, the turbulence generator comprising:

a plurality of superimposed turbulence pipes arranged in rows extending across the entire width of the headbox, through which a stock suspension flow to be conducted from the headbox to a web former is arranged to flow; and

portions of each turbulence pipe which define a stepped expansion of the flow cross-section area in the space between an inlet end and an outlet end of each pipe, the stepped expansion of each turbulence pipe being positioned at an expansion spot, wherein in superimposed pipe rows, the distance of the expansion spot of the turbulence pipes from the slice opening of the headbox in association with the pipe rows, is different in that at the slice opening a different turbulence prevails in different layers of the stock suspension flow.

16. The turbulence generator of claim 15, further comprising:

a plurality of trailing elements connected to the turbulence generator, starting from between the pipe rows and extending towards the slice duct of the headbox, each trailing element having a tip at its downstream end; and

wherein in superimposed pipe rows, the distance of the tips of the trailing elements from the slice opening of the headbox in association with the pipe rows, is different in that at the slice opening a different turbulence prevails in different layers of the stock suspension flow.

17. The turbulence generator of claim 15, wherein the superimposed rows of turbulence pipes include a centermost row of pipes, and wherein the expansion spots of the pipes within a row are positioned closer to the slice opening of the headbox, the closer said pipe row is to the centermost pipe row.

18. The turbulence generator of claim 15, wherein the superimposed rows of turbulence pipes include a lowermost row of pipes, and wherein the expansion spots in a row are closer to the slice opening of the headbox, the farther said pipe row is from the lowermost pipe row of the turbulence generator.

19. A paper machine headbox turbulence generator for the headbox of a paper machine, the headbox having a width, the turbulence generator comprising:

a plurality of superimposed turbulence pipes arranged in rows extending across the entire width of the headbox, through which a stock suspension flow to be conducted from the headbox to a web former is arranged to flow; and

a plurality of trailing elements connected to the turbulence generator, starting from between the pipe rows and extending towards the slice duct of the headbox, each trailing element having a tip at its downstream end; and

portions of each turbulence pipe which define a stepped expansion of the flow cross-section area in the space between an inlet end and an outlet end of each pipe, the stepped expansion of each turbulence pipe being positioned at an expansion spot, wherein in superimposed pipe rows, the distance of the tips of the trailing elements from the slice opening of the headbox in association with the pipe rows, is different in that at the slice opening a different turbulence prevails in different layers of the stock suspension flow.

20. The turbulence generator of claim 19, wherein the turbulence pipes of superimposed pipe rows have different flow cross-section areas.

21. The turbulence generator of claim 20, wherein the flow cross-section areas of the turbulence pipes of one of the superimposed pipe rows are greater, the closer said pipe row is to a centermost pipe row of the turbulence generator.

22. The turbulence generator according of claim 20, wherein the flow cross-section areas of the turbulence pipes of one of the superimposed pipe rows are greater, the closer said pipe row is to a centermost pipe row of the turbulence generator.

23. The turbulence generator of claim 20, wherein the flow cross-section areas of the turbulence pipes of one of the superimposed pipe rows are greater, the closer said pipe row is to a centermost pipe row of the turbulence generator.

24. A paper machine headbox apparatus having a width,comprising:

a first row of a plurality of turbulence pipes extending across the entire width of the headbox;

a second row of turbulence pipes extending across the entire width of the headbox, and positioned below the first row;

a third row of turbulence pipes extending across the entire width of the headbox, and below the second row, wherein each turbulence pipe is comprised of an initial section of a first cross-sectional area, and an end section downstream of the initial section, the initial section being connected to the end section at a stepwise expansion point, at which the cross-sectional area increases, and

a slice duct positioned to receive stock suspension flow from the turbulence pipes and discharging through a slice opening to a web former, wherein the stock suspension flow is distributed into a plurality of layers by the rows of turbulence pipes, turbulence being generated in different layers of the flow in different phases of the flow by the stepwise expansion points, the spacing of the stepwise expansion points from the slice opening being different depending on the row in which a particular turbulence pipe is located, such that at the slice opening, a different turbulence prevails in different layers of the stock suspension flow.

25. The paper machine headbox apparatus of claim 24 further comprising a plurality of trailing elements, each trailing element starting from between two turbulence pipe rows and extending towards the slice duct of the headbox, each trailing element having a tip at its downstream end; and the distance of the tips of the trailing elements from the slice opening of the headbox is not the same for all trailing elements.

26. The turbulence generator of claim 24, wherein the second row of turbulence pipes is the centermost row, and wherein the expansion spots of the turbulence pipes within a row are positioned closer to the slice opening of the headbox, the closer said pipe row is to the centermost pipe row.

27. The turbulence generator of claim 24, wherein the third row of turbulence pipes is a lowermost row, and wherein the expansion spots in a row are closer to the slice opening of the headbox, the farther said pipe row is from the lowermost pipe row of the turbulence generator.

Applicant: Sakari Soini
PCT App. No.: PCT/FI00/00843

28. A paper machine headbox apparatus comprising:

a first row of turbulence pipes;

a second row of turbulence pipes below the first row;

a third row of turbulence pipes below the second row, wherein each turbulence pipe is comprised of an initial section of a first cross-sectional area, and an end section downstream of the initial section, the initial section being connected to the end section at a stepwise expansion point, at which the cross-sectional area increases;

a plurality of trailing elements, each trailing element starting from between two turbulence pipe rows and extending towards the slice duct of the headbox, each trailing element having a tip at its downstream end, and the distance of the tips of the trailing elements from the slice opening of the headbox is not the same for all trailing elements; and

a slice duct positioned to receive stock suspension flow from the turbulence pipes and discharging through a slice opening to a web former, wherein the stock suspension flow is distributed into a plurality of layers by the rows of turbulence pipes, turbulence being generated in different layers of the flow in different phases of the flow by the stepwise expansion points and the trailing elements, such that at the slice opening, a different turbulence prevails in different layers of the stock suspension flow.

29. The turbulence generator of claim 28, wherein the second row of turbulence pipes is the centermost row, and wherein the cross-sectional areas after the stepwise expansion points of the turbulence pipes of the first row and the third row are less than the cross-sectional areas after the stepwise expansion points of the centermost row.

Applicant: Sakari Soini
PCT App. No.: PCT/FI00/00843

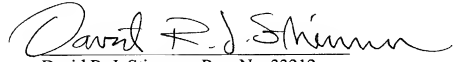
30. The turbulence generator of claim 28, wherein the third row of turbulence pipes is the lowermost row, and wherein the cross-sectional areas after the stepwise expansion points of the turbulence pipes of the second row are greater than the cross-sectional areas after the stepwise expansion points of the lowermost row, and the cross-sectional areas after the stepwise expansion points of the first row are greater than the cross-sectional areas after the stepwise expansion points of the second row.

REMARKS

Claims 11–30 remain pending in the application.

Applicant believes that no new matter has been added by these amendments and that the application, as amended, is ready for examination. Favorable action thereon is respectfully solicited.

Respectfully submitted,



David R. J. Stiennon, Reg. No. 33212
Attorney for Applicant
Lathrop & Clark LLP
740 Regent Street, Suite 400, P.O. Box 1507
Madison, Wisconsin 53701-1507
(608) 257-7766

Amdt1.app

In The United States Patent And Trademark Office

Applicant:	Sakari Soini	Date:	April 3, 2002
Date Filed:	Simultaneously herewith	Docket No.:	FORSAL-39
PCT App. No.:	PCT/FI00/00843		

For: Procedure and Means for Generating Turbulence in Stock Suspension Flow

Certificate of Express Mailing
I hereby certify that this document is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 35 C.F.R. §1.10
on April 3, 2002
with Mailing Label No. EV 015 204 447 US
and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

David R. J. Stiennon
Signature
David R. J. Stiennon, Reg. No. 33212
Name of applicant, assignee or Registered Representative

Clean Copy of Substitute Specification under 37 C.F.R. 1.125(c)

TITLE OF THE INVENTION

Procedure and Means for Generating Turbulence in Stock Suspension Flow

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] This application is a U.S. national stage application of International Application No. PCT/FI00/00843, filed October 2, 2000, and claims priority on Finnish Application No. 19992133 filed October 4, 1999, the disclosures of both of which applications are incorporated by reference herein.

STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

Not applicable.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a procedure for generating and maintaining turbulence in stock suspension flow conducted through a turbulence generator into the slice duct of the headbox and therefrom through the slice opening to the web former, in which procedure the stock suspension flow is with the aid of turbulence pipes divided into a number of superimposed layers, whereafter the effect of the elements creating and maintaining turbulence is directed thereupon.

[0003] The invention also relates to a turbulence generator of the headbox of a paper machine, comprising a number of overlapping turbulence pipes being arranged in rows and extending across the entire width of the headbox, through which pipes the stock suspension flow to be conducted from the headbox to the web former is arranged to flow and which turbulence pipes are provided with stepwise expansion of the flow cross-section area between the inlet and outlet of the pipe, and to which turbulence generator a plurality of headbox dividers or lamellae can moreover be connected, starting from between the pipe rows and extending to the slice duct of the headbox.

[0004] It is of vital importance, considering the quality of the paper/board being manufactured, to understand what kind of turbulence spectrum of stock suspension flow prevails in the slice duct of the headbox and in the subsequent web former. The turbulence generated with the aid of the turbulence generator in the stock suspension flow will decrease quite rapidly unless turbulence energy is continuously added in the flow. The formation of paper or board is best enhanced by small-scale vortices which efficiently disintergate fibre bundles. Large-scale vortices may even be detrimental considering the formation of paper. Owing to the properties of the turbulence, the small-scale vortices are first to reduce in the flow, whereby, for instance, the surface layer of the web on the Fourdrinier wire and the middle layer of the web on a gap former tend to be more flocculated than the other layers due to decreasing turbulence. A generally employed manner to increase turbulence energy in the flow by using the draw between the slice jet and the wire does not act in the area being dewatered last. In order to have more turbulence in said area, the draw is

to be great. Hereby, the formation of the area dewatered first is easily deteriorated to the extent that the formation of the entire product can no longer be improved. A similar progress may also occur when endeavours are made in the web former to introduce turbulence energy into a stock suspension layer not yet dewatered, e.g. by means of loading lists through a layer already dewatered.

[0005] In a majority of the state-of-art turbulence generators, all turbulence pipes are mutually identical because the aim is to achieve homogeneous turbulence in different parts of the stock flow. Such turbulence generators make no difference between the bottom, surface and middle layers of the web. In web formation, said layers become, however, dewatered at different times. On the Fourdrinier wire, the surface layer is dewatered last and in the gap former the layer to be dewatered last is the middle layer.

[0006] In patent specification US. 5,124,002, a turbulence generator is disclosed in which the flow cross-section areas of the turbulence pipes in superimposed layers differ in size and shape, and advantageously, the mutual spaces between the pipes are also different. In this manner, a different microturbulence level can be generated in different layers of the stock suspension flow discharging from the turbulence generator into the slice duct, and such paper can be manufactured which is provided with different fibre orientations in superimposed layers. The flow cross-section area of each turbulence pipe remains the same from the first part of the pipe to the end thereof.

[0007] Such turbulence generators are also known in the art in which the flow cross-section area of the turbulence pipes is step-wise expanded at least at one spot between the inlet and the outlet of the pipe. In the turbulence generators known in the art, the expansion spots of the pipe are at equal distance from the outlet of the pipe in all pipes. One such prior art design is disclosed in US. patent specification *No. 5,183,537.*

SUMMARY OF THE INVENTION

[0008] The objective of the present invention is to develop a new procedure for generating and maintaining turbulence and a new kind of turbulence generator, with the aid of which a different turbulence can be generated in different layers of stock suspension flow flowing out of the headbox.

[0009] One more aim of the invention is to achieve an application in which the turbulence of the stock suspension layer dewatered last in the former after the headbox can be maintained closer to the optimal level during the formation than with currently used turbulence generators. Thus, the aim is a stock suspension flow in which the turbulence is "freshest", and consequently, most lasting in the layers of the flow which stay "running" longest. When the impact of the factors generating turbulence in the flow ceases, the turbulence begins to slow down rapidly. The turbulence is the fresher the shorter length the flow has propagated after the generation of turbulence.

[0010] To achieve said objectives and those to be disclosed below, the procedure of the invention is characterized in that turbulence is generated in different layers of the flow in different phases of the flow by arranging the elements generating and maintaining turbulence at different distances from the slice opening of the headbox, so that a different turbulence prevails in different layers of the stock suspension flow.

[0011] Respectively, the turbulence generator of the invention is characterized in that the distance of the expansion spot of the turbulence pipes in superimposed pipe rows from the slice opening of the headbox and/or the distance of the tips of the trailing elements in association with the pipe rows from the slice opening of the headbox is different so that at the slice opening, the turbulence is different in different layers of the stock suspension flow.

[0012] In an advantageous embodiment of the invention, the expansion spots of

individual turbulence pipes of a turbulence generator are so stepped that in the superimposed turbulence pipe rows, the expansion of the flow cross-section area is carried out at a different distance from the slice opening of the headbox. The later the phase is in which the cross-section area of a turbulence pipe expands, the fresher is the turbulence as the stock suspension flow discharges from the slice opening of the headbox onto the forming wire or into the gap between the forming wires. The expansion spots of the turbulence pipes acting on the layer of the stock suspension flow to be dewatered last are arranged to be last in the flow direction, that is, closest to the slice opening.

[0013] In addition to stepping the expansion spots, or instead of it, a different turbulence can be generated in different layers of the stock suspension flow by providing, after the turbulence pipes, trailing elements extending to the slice duct, which in superimposed flow layers extend to a different distance from the slice opening of the headbox. The trailing elements can be fixed in length or their lengths can be adjustable, as in US. patent specification *No. 4,133,713*. Alternatively, the fixing point of a trailing element in the longitudinal direction to the headbox can be adjustable, as in FI patent specification *No. 88317*. The purpose of the trailing elements is to keep different layers of the stock suspension flow separated as long as possible after a different turbulence has first been generated in the layers, for example, by stepping the expansion parts or by employing turbulence pipes differing in the flow cross-section area. The trailing elements maintain and strengthen the difference of turbulences prevailing between different layers. Alternatively, all trailing elements can be mutually of equal length, whereby various levels of turbulence prevailing in different layers can be achieved solely with the aid of structural differences of turbulence pipes.

[0014] The invention is described below more in detail, reference being made to the figures of the accompanying drawing, to which, however, the invention is not intended to be exclusively restricted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Figure 1 presents schematically a headbox provided with a turbulence generator of the invention, being particularly appropriate for use in connection with a gap former.

[0016] Figure 2 presents a turbulence generator which is particularly appropriate for use in connection with a Fourdrinier or hybrid former.

[0017] Figure 3 presents a turbulence generator according to a second embodiment of the invention particularly for a gap former.

[0018] Figure 4 presents a turbulence generator appropriate for Fourdrinier and hybrid formers.

[0019] Figure 5 presents a turbulence generator appropriate for a gap former, in which two advantageous embodiments of the invention are combined.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Figure 1 presents in cross-section a simplified headbox 2 for a paper machine. Stock suspension is brought to the headbox 2 via a cross-direction stock inlet header 4, wherefrom the flow is distributed into a number of distributor pipes 6 in machine direction. Subsequent to the distributor pipes 6, the stock suspension flows through an equalization chamber 8 into the flow pipes $14a_1...14a_5$ of the turbulence generator 10, and further, into a wedgewise tapering slice duct 12, wherefrom the stock suspension spray is discharged through a slice opening 13 to the web former.

[0021] The turbulence pipes $14a_1...14a_5$ of the turbulence generator 10 are arranged in five superimposed rows $R_1...R_5$ extending in cross machine direction across the entire width of the headbox 2. Each individual turbulence pipe $14a_1...14a_5$ comprises an initial section 15 relatively narrow in cross-section, expanding stepwise at point

16 into an end section 17 wider than the initial section 15. Preferably, the initial section 15 of the pipe is circular in cross-section and also the end section 17 starts circular at the expansion 16 but ends rectangular on the side of the slice cone 12, so that necks 18 are left between the superimposed turbulence pipes $14a_1...14a_5$. As known in the art, the cross-section of the latter part can also be different, such as triangle, square or polygon. The expansions 16 of the flow cross-section area in the turbulence pipes $14a_1...14a_5$ cause a change of the flow rate in the stock suspension flowing through the turbulence generator 10 and an increase in the amount of turbulence.

[0022] Thus, each row R_n of turbulence pipes comprises a plurality of parallel turbulence pipes $14a_n$, these being mutually identical in said horizontal row R_n. The subscript n refers to the order number 1 to 5 of the pipe, starting from the topmost pipe. The superimposed turbulence pipes $14a_1...14a_5$ differ from one another in the respect that the expansion spot 16 of the flow duct $14a_n$ is in different pipe rows $R_1...R_5$ placed at a different distance L_n from the slice opening 13 of the headbox. Said distance L_n reduces in the order $L_1=L_5>L_2=L_4>L_3$.

[0023] The headbox as in Figure 1 is intended for use in association with the gap former. When a web is dewatered between two wires, the middle layer thereof is dewatered last. In order to maintain a sufficient micro-turbulence level considering the achieving of uniform formation as long as possible also in the middle layer of the stock flow being dewatered last, the expansion points 16 in the centermost row of pipes R_3 are positioned closest to the outlet end of the turbulence generator 10 and the slice opening 13 of the headbox, respectively, in the topmost R_1 and the lowermost R_5 pipe row, the expansion points 16 are farthermost from the outlet end of the turbulence generator 10.

[0024] Figure 2 presents a turbulence generator 10 which is particularly appropriate for use in association with the web forming units starting with a Fourdrinier wire portion. The means comprises four superimposed rows $R_1...R_4$ of

turbulence pipes $14b_1...14b_4$. The expansion spots 16 of the turbulence pipes are in this instance stepped to grow in that the space L_4 between the expansion 16 and the slice opening 13 in the turbulence pipes $14b_4$ of the lowermost pipe row R_4 is greatest and in the topmost pipe row R_1, the respective distance L_1 is smallest. The lowest layer of the stock suspension flow sprayed onto the Fourdrinier wire is filtered first and the topmost layer, last. To have the turbulence maintained longer in the upper stock suspension layer being dewatered last, the locations of the expansion 16 of the flow cross-section area are in the present embodiment stepped so that the expansions 16 in the lowermost pipe row R_4 closest to the level of the Fourdrinier wire are earlier in the flow direction and the pipe expansions 16 in the topmost pipe row R_1 farthermost from the Fourdrinier wire are last in the flow direction.

[0025] Figure 3 shows a turbulence generator for a gap former according to another embodiment of the invention. In this instance, the stepped expansion 16 located between the narrow initial part 15 of the turbulence pipe $14c_1...14c_4$ and the wide latter part 17 thereof is in all four superimposed rows $R_1...R_4$ of turbulence pipes in the flow direction at one and same distance from the slice opening 13 of the headbox. Instead, the superimposed turbulence pipes $14c_1...14c_4$ have different cross-sections so that the cross-section areas of the topmost and the lowermost turbulence pipes $14c_1$ and $14c_3$ are smaller than the cross-section areas of the two centermost turbulence pipes $14c_2$ and $14c_3$. The greater the cross-section of the flow duct, the greater in dimension is the turbulence generated in the pipe. A turbulence of a greater dimension also slows down more slowly than a turbulence of a smaller dimension.

[0026] A turbulence generator as in Figure 3 comprises further three trailing elements $20a_1...20a_3$ fastened as extensions to necks 18 separating the three superimposed pipe rows $R_1...R_4$ from each other, said elements extending to the slice cone 12 of the headbox. The purpose of the trailing elements $20a_1...20a_3$ is to keep the stock suspension flows of turbulence of different magnitude, coming from turbulence pipes $14c_1...14c_4$, apart from each other and in addition, to generate

and/or to maintain the turbulence of the flow. In the design of the invention, said three trailing elements $20a_1...20a_3$ are different in length so that the topmost and the lowermost trailing elements $20a_1$ and $20a_3$ extend to the same distance $s_1 = s_3$ from the slice opening 13 of the headbox, and the middlemost trailing element $20a_2$ is shorter than the others, extending to distance s_2.

[0027] The turbulence generator in Figure 4 is intended for a Fourdrinier or hybrid former. As in Figure 3, also in the present embodiment the cross-section areas of the turbulence pipes $14d_1...14d_3$ arranged in three superimposed rows $R_1...R_3$ are different so that the cross-section area in the lowermost pipe row $14d_3$ is smallest and the cross-section area in the topmost pipe row $14d_1$, and hence, also the dimension of the turbulence generated in the flow, is greatest. The lengths of two trailing elements $20b_1$ and $20b_2$ fastened as continuations to pipe rows $R_1...R_3$ are arranged so that the distance S_2 of the tip of the trailing element $20b_2$ from the slice opening 13 separating the two lowermost stock flows from each other is greater than the respective distance s_1 of the trailing element $20b_1$ separating the two topmost stock flows from each other.

[0028] Figure 5 presents a turbulence generator appropriate for a gap former, in which the technology of Figure 1 and Figure 3 is combined in an advantageous fashion. The expansion spots 16 in superimposed rows $R_1...R_5$ of turbulence pipes $14a_1...14a_5$ are so stepped that the centermost turbulence pipe $14a_3$ expands last in the flow direction and the two sidemost turbulence pipes $14a_1$ and $14a_5$ expand first in the flow direction. As extensions to the partitions 18 of the turbulence pipes $14a_1...14a_5$, four trailing elements $20c_1...20c_4$ are arranged, of which the distance $s_2 = s_3$ of the tips of two centermost trailing elements $20c_2$ and $20c_3$ is smaller than the respective distance $s_1 = s_4$ of the two trailing elements $20c_1$ and $20c_4$ closer to the edge.

[0029] Also several other modifications of the invention are conceivable within the scope of the claims presented below. For instance, the trailing elements

separating superimposed flows from each other can be mutually of identical dimensions when a layered turbulence has been generated in the stock suspension flow already in the preceding turbulence pipes.

ABSTRACT OF THE DISCLOSURE

In a paper machine headbox, a stock suspension flow passes through turbulence pipes ($14a_n$) and is distributed into superimposed layers. Stepped expansion spots (16) of the flow cross-section area of the turbulence pipes (14) or the positions of trailing elements starting from between the pipe rows (R_n) and extending to the slice duct (12) of the headbox control the onset and level of turbulence in each layer. Turbulence is generated in different phases of the flow in different layers by arranging the expansion spots (16) and/or the trailing elements in superimposed layers to be located at different distances from the slice opening (13) of the headbox, whereby a different turbulence prevails at the slice opening (13) in different layers of the stock suspension flow.

In The United States Patent And Trademark Office

Applicant: Sakari Soini Date: April 3, 2002

Date Filed: Simultaneously herewith Docket No.: FORSAL-39

PCT App. No.: PCT/FI00/00843

For: Procedure and Means for Generating Turbulence in Stock Suspension Flow

Certificate of Express Mailing
I hereby certify that this document is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 35 C.F.R. §1.10
on April 3, 2002
with Mailing Label No. EV015204447US
and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

David R. J. Stiennon
Signature
David R. J. Stiennon, Reg. No. 33212
Name of applicant, assignee or Registered Representative

Marked Up Copy of Substitute Specification under 37 C.F.R. 1.125(b)(2)

TITLE OF THE INVENTION

Procedure and **[m]**Means for **[g]**Generating **[t]**Turbulence in **[s]**Stock **[s]**Suspension **[flow]Flow**

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] This application is a U.S. national stage application of International Application No. PCT/FI00/00843, filed October 2, 2000, and claims priority on Finnish Application No. 19992133 filed October 4, 1999, the disclosures of both of which applications are incorporated by reference herein.

STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

Not applicable.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a procedure for generating and maintaining turbulence in stock suspension flow conducted through a turbulence generator into the slice duct of the headbox and therefrom through the slice opening to the web former, in which procedure the stock suspension flow is with the aid of turbulence pipes divided into a number of superimposed layers, whereafter the effect of the elements creating and maintaining turbulence is directed thereupon.

[ ]

[0003] The invention also relates to a turbulence generator of the headbox of a paper machine, comprising a number of overlapping turbulence pipes being arranged in rows and extending across the entire width of the headbox, through which pipes the stock suspension flow to be conducted from the headbox to the web former is arranged to flow and which turbulence pipes are provided with stepwise expansion of the flow cross-section area between the inlet and outlet of the pipe, and to which turbulence generator a plurality of headbox dividers or lamellae can moreover be connected, starting from between the pipe rows and extending to the slice duct of the headbox.

[0004] It is of vital importance, considering the quality of the **[paper / board]paper/board** being manufactured, to understand what kind of turbulence spectrum of stock suspension flow prevails in the slice duct of the headbox and in the subsequent web former. The turbulence generated with the aid of the turbulence generator in the stock suspension flow will decrease quite rapidly unless turbulence energy is continuously added in the flow. The formation of paper or board is best enhanced by small-scale vortices which efficiently disintergate fibre bundles. Large-scale vortices may even be detrimental considering the formation of paper. Owing to the properties of the turbulence, the small-scale vortices are first to reduce in the flow, whereby, for instance, the surface layer of the web on the Fourdrinier wire and the middle layer of the web on a gap former tend to be more flocculated than the other layers due to decreasing turbulence. A generally employed manner to increase turbulence energy in the flow by using the draw between the slice jet and the wire

does not act in the area being dewatered last. In order to have more turbulence in said area, the draw is to be great. Hereby, the formation of the area dewatered first is easily deteriorated to the extent that the formation of the entire product can no longer be improved. A similar progress may also occur when endeavours are made in the web former to introduce turbulence energy into a stock suspension layer not yet dewatered, e.g. by means of loading lists through a layer already dewatered.

[0005] In a majority of the state-of-art turbulence generators, all turbulence pipes are mutually identical because the aim is to achieve homogeneous turbulence in different parts of the stock flow. Such turbulence generators make no difference between the bottom, surface and middle layers of the web. In web formation, said layers become, however, dewatered at different times. On the Fourdrinier wire, the surface layer is dewatered last and in the gap former the layer to be dewatered last is the middle layer.

[0006] In patent specification []US. 5,124,002, a turbulence generator is disclosed in which the flow cross-section areas of the turbulence pipes in superimposed layers differ in size and shape, and advantageously, the mutual spaces between the pipes are also different. In this manner, a different microturbulence level can be generated in different layers of the stock suspension flow discharging from the turbulence generator into the slice duct, and such paper can be manufactured which is provided with different fibre orientations in superimposed layers. The flow cross-section area of each turbulence pipe remains the same from the first part of the pipe to the end thereof.

[0007] Such turbulence generators are also known in the art in which the flow cross-section area of the turbulence pipes is step-wise expanded at least at one spot between the inlet and the outlet of the pipe. In the turbulence generators known in the art, the expansion spots of the pipe are at equal distance from the outlet of the pipe in all pipes. One such prior art design is disclosed in US. patent specification *No. 5,183,537.*

SUMMARY OF THE INVENTION

[0008] The objective of the present invention is to develop a new procedure for generating and maintaining turbulence and a new kind of turbulence generator, with the aid of which a different turbulence can be generated in different layers of stock suspension flow flowing out of the headbox.

[0009] One more aim of the invention is to achieve an application in which the turbulence of the stock suspension layer dewatered last in the former after the headbox can be maintained closer to the optimal level during the formation than with currently used turbulence generators. Thus, the aim is a stock suspension flow in which the turbulence is "freshest", and consequently, most lasting in the layers of the flow which stay "running" longest. When the impact of the factors generating turbulence in the flow ceases, the turbulence begins to slow down rapidly. The turbulence is the fresher the shorter length the flow has propagated after the generation of turbulence.

[0010] To achieve said objectives and those to be disclosed below, the procedure of the invention is characterized in that turbulence is generated in different layers of the flow in different phases of the flow by arranging the elements generating and maintaining turbulence at different distances from the slice opening of the headbox, so that a different turbulence prevails in different layers of the stock suspension flow.

[0011] Respectively, the turbulence generator of the invention is characterized in that the distance of the expansion spot of the turbulence pipes in superimposed pipe rows from the slice opening of the headbox and/or the distance of the tips of the trailing elements in association with the pipe rows from the slice opening of the headbox is different so that at the slice opening, the turbulence is different in different layers of the stock suspension flow.

[0012] In an advantageous embodiment of the invention, the expansion spots of

individual turbulence pipes of a turbulence generator are so stepped that in the superimposed turbulence pipe rows, the expansion of the flow cross-section area is carried out at a different distance from the slice opening of the headbox. The later the phase is in which the cross-section area of a turbulence pipe expands, the fresher is the turbulence as the stock suspension flow discharges from the slice opening of the headbox onto the forming wire or into the gap between the forming wires. The expansion spots of the turbulence pipes acting on the layer of the stock suspension flow to be dewatered last are arranged to be last in the flow direction, that is, closest to the slice opening.

[0013] In addition to stepping the expansion spots, or instead of it, a different turbulence can be generated in different layers of the stock suspension flow by providing, after the turbulence pipes, trailing elements extending to the slice duct, which in superimposed flow layers extend to a different distance from the slice opening of the headbox. The trailing elements can be fixed in length or their lengths can be adjustable, as in US. patent specification *No. 4,133,713*. Alternatively, the fixing point of a trailing element in the longitudinal direction to the headbox can be adjustable, as in FI patent specification *No. 88317*. The purpose of the trailing elements is to keep different layers of the stock suspension flow separated as long as possible after a different turbulence has first been generated in the layers, for example, by stepping the expansion parts or by employing turbulence pipes differing in the flow cross-section area. The trailing elements maintain and strengthen the difference of turbulences prevailing between different layers. Alternatively, all trailing elements can be mutually of equal length, whereby various levels of turbulence prevailing in different layers can be achieved solely with the aid of structural differences of turbulence pipes.

[0014] The invention is described below more in detail, reference being made to the figures of the accompanying drawing, to which, however, the invention is not intended to be exclusively restricted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Figure 1 presents schematically a headbox provided with a turbulence generator of the invention, being particularly appropriate for use in connection with a gap former.

[0016] Figure 2 presents a turbulence generator which is particularly appropriate for use in connection with a Fourdrinier or hybrid**[e]** former.

[0017] Figure 3 presents a turbulence generator according to a second embodiment of the invention particularly for a gap former.

[0018] Figure 4 presents a turbulence generator appropriate for Fourdrinier and hybrid**[e]** formers.**[ ]**

[0019] Figure 5 presents a turbulence generator appropriate for a gap former, in which two advantageous embodiments of the invention are combined.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Figure 1 presents in cross-section a simplified headbox 2 for a paper machine. Stock suspension is brought to the headbox 2 via a cross-direction stock inlet header 4, wherefrom the flow is distributed into a number of distributor pipes **6** in machine direction. Subsequent to the distributor pipes 6, the stock suspension flows through an equalization chamber 8 into the flow pipes $14a_1...14a_5$ of the turbulence generator 10, and further, into a wedgewise tapering slice duct 12, wherefrom the stock suspension spray is discharged through a slice opening 13 to the web former.

[0021] The turbulence pipes $14a_1...14a_5$ of the turbulence generator 10 are arranged in five superimposed rows $R_1...R_5$ extending in cross machine direction across the entire width of the headbox 2. Each individual turbulence pipe $14a_1...14a_5$ comprises an initial section 15 relatively narrow in cross-section, expanding stepwise at point

16 into an end section 17 wider than the initial section 15. Preferably, the initial section 15 of the pipe is circular in cross-section and also the end section 17 starts circular at the expansion 16 but ends rectangular on the side of the slice cone 12, so that necks 18 are left between the superimposed turbulence pipes $14a_1...14a_5$. As known in the art, the cross-section of the latter part can also be different, such as triangle, square or polygon. The expansions 16 of the flow cross-section area in the turbulence pipes $14a_1...14a_5$ cause a change of the flow rate in the stock suspension flowing through the turbulence generator 10 and an increase in the amount of turbulence.

[0022] Thus, each row R_n of turbulence pipes comprises a plurality of parallel turbulence pipes $14a_n$, these being mutually identical in said horizontal row R_n. The subscript n refers to the order number 1 to 5 of the pipe, starting from the topmost pipe. The superimposed turbulence pipes $14a_1...14a_5$ differ from one another in the respect that the expansion spot 16 of the flow duct $14a_n$ is in different pipe rows $R_1...R_5$ placed at a different distance **[l]**L_n from the slice opening 13 of the headbox. Said distance **[l]**L_n reduces in the order $[l_1=l_5>l_2=l_4>l_3]L_1=L_5>L_2=L_4>L_3$.

[0023] The headbox as in Figure 1 is intended for use in association with the gap former. When a web is dewatered between two wires, the middle layer thereof is dewatered last. In order to maintain a sufficient micro-turbulence level considering the achieving of uniform formation as long as possible also in the middle layer of the stock flow being dewatered last, the **[expansions]expansion points** 16 in the **[centremost]centermost** row of pipes R_3 are positioned closest to the outlet end of the turbulence generator 10 and the slice opening 13 of the headbox, respectively, in the topmost R_1 and the lowermost R_5 pipe row, the **[expansions]expansion points** 16 are farthermost from the outlet end of the turbulence generator 10.

[0024] Figure 2 presents a turbulence generator 10 which is particularly appropriate for use in association with the web forming units starting with a Fourdrinier wire portion. The means comprises four superimposed rows $R_1...R_4$ of

turbulence pipes $14b_1$...$14b_4$. The expansion spots 16 of the turbulence pipes are in this instance stepped to grow in that the space $[1_4]L_4$ between the expansion 16 and the slice opening 13 in the turbulence pipes $14b_4$ of the lowermost pipe row R_4 is greatest and in the topmost pipe row R_1, the respective distance $[1_1]L_1$ is smallest. The lowest layer of the stock suspension flow sprayed onto the Fourdrinier wire is filtered first and the topmost layer, last. To have the turbulence maintained longer in the upper stock suspension layer being dewatered last, the locations of the expansion 16 of the flow cross-section area are in the present embodiment stepped so that the expansions 16 in the lowermost pipe row R_4 closest to the level of the Fourdrinier wire are earlier in the flow direction and the pipe expansions 16 in the topmost pipe row R_1 farthermost from the Fourdrinier wire are last in the flow direction.

[0025] Figure 3 shows a turbulence generator for a gap former according to another embodiment of the invention. In this instance, the stepped expansion 16 located between the narrow initial part 15 of the turbulence pipe $14c_1$...$14c_4$ and the wide latter part 17 thereof is in all four superimposed rows R_1...R_4 of turbulence pipes in the flow direction at one and same distance from the slice opening 13 of the headbox. Instead, the superimposed turbulence pipes $14c_1$...$14c_4$ have different cross-sections so that the cross-section areas of the topmost and the lowermost turbulence pipes $14c_1$ and $14c_3$ are smaller than the cross-section areas of the two **[centremost]centermost** turbulence pipes $14c_2$ and $14c_3$. The greater the cross-section of the flow duct, the greater in dimension is the turbulence generated in the pipe. A turbulence of a greater dimension also slows down more slowly than a turbulence of a smaller dimension.

[0026] A turbulence generator as in Figure 3 comprises further three trailing elements $20a_1$...$20a_3$ fastened as extensions to necks 18 separating the three superimposed pipe rows R_1...R_4 from each other, said elements extending to the slice cone 12 of the headbox. The purpose of the trailing elements $20a_1$...$20a_3$ is to keep the stock suspension flows of turbulence of different magnitude, coming from turbulence pipes $14c_1$...$14c_4$, apart from each other and in addition, to generate

and/or to maintain the turbulence of the flow. In the design of the invention, said three trailing elements $20a_1...20a_3$ are different in length so that the topmost and the lowermost trailing elements $20a_1$ and $20a_3$ extend to the same distance $s_1 = s_3$ from the slice opening 13 of the headbox, and the middlemost trailing element $20a_2$ is shorter than the others, extending to distance s_2.

[0027] The turbulence generator in Figure 4 is intended for a Fourdrinier or hybrid**[e]** former. As in Figure 3, also in the present embodiment the cross-section areas of the turbulence pipes $14d_1...14d_3$ arranged in three superimposed rows $R_1...R_3$ are different so that the cross-section area in the lowermost pipe row $14d_3$ is smallest and the cross-section area in the topmost pipe row $14d_1$, and hence, also the dimension of the turbulence generated in the flow, is greatest. The lengths of two trailing elements $20b_1$ and $20b_2$ fastened as continuations to pipe rows $R_1...R_3$ are arranged so that the distance S_2 of the tip of the trailing element $20b_2$ from the slice opening 13 separating the two lowermost stock flows from each other is greater than the respective distance s_1 of the trailing element $20b_1$ separating the two topmost stock flows from each other.

[0028] Figure 5 presents a turbulence generator appropriate for a gap former, in which the technology of Figure 1 and Figure 3 is combined in an advantageous fashion. The expansion spots 16 in superimposed rows $R_1...R_5$ of turbulence pipes $14a_1...14a_5$ are so stepped that the **[centremost]**<u>centermost</u> turbulence pipe $14a_3$ expands last in the flow direction and the two sidemost turbulence pipes $14a_1$ and $14a_5$ expand first in the flow direction. As extensions to the partitions 18 of the turbulence pipes $14a_1...14a_5$, four trailing elements $20c_1...20c_4$ are arranged, of which the distance $s_2 = s_3$ of the tips of two **[centremost]**<u>centermost</u> trailing elements $20c_2$ and $20c_3$ is smaller than the respective distance $s_1 = s_4$ of the two trailing elements $20c_1$ and $20c_4$ closer to the edge.

[0029] Also several other modifications of the invention are conceivable within the scope of the claims presented below. For instance, the trailing elements separating

superimposed flows from each other can be mutually of identical dimensions when a layered turbulence has been generated in the stock suspension flow already in the preceding turbulence pipes.

[Abstract

The present invention relates to a procedure for generating and maintaining turbulence in]

ABSTRACT OF THE DISCLOSURE

In a paper machine headbox, a stock suspension flow **[being conducted through a turbulence generator (10) into the slice duct (12) of the headbox and therefrom through a slice opening (13) to the web former. The invention also relates to the turbulence generator, comprising a number of superimposed]passes through** turbulence pipes ($14a_n$) **[arranged in rows (R_n) extending across the entire width of the headbox. The stock suspension flow is with the aid of the turbulence pipes ($14a_n$)]and is** distributed into**[several]** superimposed layers**[, and the impact of the turbulence generating and maintaining elements (16) is directed thereto, for which elements the s]. S**tepped expansion spots (16) of the flow cross-section area of **[a]the** turbulence pipe**s** (14) **[are used, and/or]or** the **positions of** trailing elements starting from between the pipe rows (R_n) and extending to the slice duct (12) of the headbox**[. I] control the onset and level of turbulence i**n **[different]each** layer**[s of the flow, t]. T**urbulence is generated in different phases of the flow **in different layers** by arranging **[said]the** expansion spots (16) and/or the trailing elements in superimposed layers to be located at different distances from the slice opening (13) of the headbox, whereby a different turbulence prevails at the slice opening (13) in different layers of the stock suspension flow.

3/PRTS

Procedure and means for generating turbulence in stock suspension flow

The present invention relates to a procedure for generating and maintaining turbulence in stock suspension flow conducted through a turbulence generator into the slice duct of the headbox and therefrom through the slice opening to the web former, in which procedure the stock suspension flow is with the aid of turbulence pipes divided into a number of superimposed layers, whereafter the effect of the elements creating and maintaining turbulence is directed thereupon.

The invention also relates to a turbulence generator of the headbox of a paper machine, comprising a number of overlapping turbulence pipes being arranged in rows and extending across the entire width of the headbox, through which pipes the stock suspension flow to be conducted from the headbox to the web former is arranged to flow and which turbulence pipes are provided with stepwise expansion of the flow cross-section area between the inlet and outlet of the pipe, and to which turbulence generator a plurality of headbox dividers or lamellae can moreover be connected, starting from between the pipe rows and extending to the slice duct of the headbox.

It is of vital importance, considering the quality of the paper / board being manufactured, to understand what kind of turbulence spectrum of stock suspension flow prevails in the slice duct of the headbox and in the subsequent web former. The turbulence generated with the aid of the turbulence generator in the stock suspension flow will decrease quite rapidly unless turbulence energy is continuously added in the flow. The formation of paper or board is best enhanced by small-scale vortices which efficiently disintergate fibre bundles. Large-scale vortices may even be detrimental considering the formation of paper. Owing to the properties of the turbulence, the small-scale vortices are first to reduce in the

flow, whereby, for instance, the surface layer of the web on the Fourdrinier wire and the middle layer of the web on a gap former tend to be more flocculated than the other layers due to decreasing turbulence. A generally employed manner to increase turbulence energy in the flow by using the draw between the slice jet and the wire does not act in the area being dewatered last. In order to have more turbulence in said area, the draw is to be great. Hereby, the formation of the area dewatered first is easily deteriorated to the extent that the formation of the entire product can no longer be improved. A similar progress may also occur when endeavours are made in the web former to introduce turbulence energy into a stock suspension layer not yet dewatered, e.g. by means of loading lists through a layer already dewatered.

In majority of the state-of-art turbulence generators, all turbulence pipes are mutually identical because the aim is to achieve homogeneous turbulence in different parts of the stock flow. Such turbulence generators make no difference between the bottom, surface and middle layers of the web. In web formation, said layers become, however, dewatered at different times. On the Fourdrinier wire, the surface layer is dewatered last and in the gap former the layer to be dewatered last is the middle layer.

In patent specification *US. 5,124,002*, a turbulence generator is disclosed in which the flow cross-section areas of the turbulence pipes in superimposed layers differ in size and shape, and advantageously, the mutual spaces between the pipes are also different. In this manner, a different microturbulence level can be generated in different layers of the stock suspension flow discharging from the turbulence generator into the slice duct, and such paper can be manufactured which is provided with different fibre orientations in superimposed layers. The flow cross-section area of each turbulence pipe remains the same from the first part of the pipe to the end thereof.

Such turbulence generators are also known in the art in which the flow cross-section area of the turbulence pipes is step-wise expanded at least at one spot between the inlet and the outlet of the pipe. In the turbulence generators known in the art, the expansion spots of the pipe are at equal distance from the outlet of the pipe in all pipes. One such prior art design is disclosed in US. patent specification *No. 5,183,537*.

The objective of the present invention is to develop a new procedure for generating and maintaining turbulence and a new kind of turbulence generator, with the aid of which a different turbulence can be generated in different layers of stock suspension flow flowing out of the headbox.

One more aim of the invention is to achieve an application in which the turbulence of the stock suspension layer dewatered last in the former after the headbox can be maintained closer to the optimal level during the formation than with currently used turbulence generators. Thus, the aim is a stock suspension flow in which the turbulence is "freshest", and consequently, most lasting in the layers of the flow which stay "running" longest. When the impact of the factors generating turbulence in the flow ceases, the turbulence begins to slow down rapidly. The turbulence is the fresher the shorter length the flow has propagated after the generation of turbulence.

To achieve said objectives and those to be disclosed below, the procedure of the invention is characterized in that turbulence is generated in different layers of the flow in different phases of the flow by arranging the elements generating and maintaining turbulence at different distances from the slice opening of the headbox, so that a different turbulence prevails in different layers of the stock suspension flow.

Respectively, the turbulence generator of the invention is characterized in that the distance of the expansion spot of the turbulence pipes in superimposed pipe rows

from the slice opening of the headbox and/or the distance of the tips of the trailing elements in association with the pipe rows from the slice opening of the headbox is different so that at the slice opening, the turbulence is different in different layers of the stock suspension flow.

In an advantageous embodiment of the invention, the expansion spots of individual turbulence pipes of a turbulence generator are so stepped that in the superimposed turbulence pipe rows, the expansion of the flow cross-section area is carried out at a different distance from the slice opening of the headbox. The later the phase is in which the cross-section area of a turbulence pipe expands, the fresher is the turbulence as the stock suspension flow discharges from the slice opening of the headbox onto the forming wire or into the gap between the forming wires. The expansion spots of the turbulence pipes acting on the layer of the stock suspension flow to be dewatered last are arranged to be last in the flow direction, that is, closest to the slice opening.

In addition to stepping the expansion spots, or instead of it, a different turbulence can be generated in different layers of the stock suspension flow by providing, after the turbulence pipes, trailing elements extending to the slice duct, which in superimposed flow layers extend to a different distance from the slice opening of the headbox. The trailing elements can be fixed in length or their lengths can be adjustable, as in US. patent specification *No. 4,133,713.* Alternatively, the fixing point of a trailing element in the longitudinal direction to the headbox can be adjustable, as in FI patent specification *No. 88317.* The purpose of the trailing elements is to keep different layers of the stock suspension flow separated as long as possible after a different turbulence has first been generated in the layers, for example, by stepping the expansion parts or by employing turbulence pipes differing in the flow cross-section area. The trailing elements maintain and strengthen the difference of turbulences prevailing between different layers. Alternatively, all trailing elements can be mutually of equal length, whereby

various levels of turbulence prevailing in different layers can be achieved solely with the aid of structural differences of turbulence pipes.

The invention is described below more in detail, reference being made to the figures of the accompanying drawing, to which, however, the invention is not intended to be exclusively restricted.

Figure 1 presents schematically a headbox provided with a turbulence generator of the invention, being particularly appropriate for use in connection with a gap former.

Figure 2 presents a turbulence generator which is particularly appropriate for use in connection with a Fourdrinier or hybride former.

Figure 3 presents a turbulence generator according to a second embodiment of the invention particularly for a gap former.

Figure 4 presents a turbulence generator appropriate for Fourdrinier and hybride formers.

Figure 5 presents a turbulence generator approriate for a gap former, in which two advantageous embodiments of the invention are combined.

Figure 1 presents in cross-section a simplified headbox 2 for a paper machine. Stock suspension is brought to the headbox 2 via a cross-direction stock inlet header 4, wherefrom the flow is distributed into a number of distributor pipes in machine direction. Subsequent to the distributor pipes 6, the stock suspension flows through an equalization chamber 8 into the flow pipes $14a_1 ... 14a_5$ of the turbulence generator 10, and further, into a wedgewise tapering slice duct 12, wherefrom the stock suspension spray is discharged through a slice opening 13 to the web former.

The turbulence pipes $14a_1...14a_5$ of the turbulence generator 10 are arranged in five superimposed rows $R_1...R_5$ extending in cross machine direction across the entire width of the headbox 2. Each individual turbulence pipe $14a_1...14a_5$ comprises an initial section 15 relatively narrow in cross-section, expanding stepwise at point 16 into an end section 17 wider than the initial section 15. Preferably, the initial section 15 of the pipe is circular in cross-section and also the end section 17 starts circular at the expansion 16 but ends rectangular on the side of the slice cone 12, so that necks 18 are left between the superimposed turbulence pipes $14a_1...14a_5$. As known in the art, the cross-section of the latter part can also be different, such as triangle, square or polygon. The expansions 16 of the flow cross-section area in the turbulence pipes $14a_1...14a_5$ cause a change of the flow rate in the stock suspension flowing through the turbulence generator 10 and an increase in the amount of turbulence.

Thus, each row R_n of turbulence pipes comprises a plurality of parallel turbulence pipes $14a_n$, these being mutually identical in said horizontal row R_n. The subscript n refers to the order number 1 to 5 of the pipe, starting from the topmost pipe. The superimposed turbulence pipes $14a_1...14a_5$ differ from one another in the respect that the expansion spot 16 of the flow duct $14a_n$ is in different pipe rows $R_1...R_5$ placed at a different distance l_n from the slice opening 13 of the headbox. Said distance l_n reduces in the order $l_1=l_5>l_2=l_4>l_3$.

The headbox as in Figure 1 is intended for use in association with the gap former. When a web is dewatered between two wires, the middle layer thereof is dewatered last. In order to maintain a sufficient micro-turbulence level considering the achieving of uniform formation as long as possible also in the middle layer of the stock flow being dewatered last, the expansions 16 in the centremost row of pipes R_3 are positioned closest to the outlet end of the turbulence generator 10 and the slice opening 13 of the headbox, respectively, in

the topmost R_1 and the lowermost R_5 pipe row, the expansions 16 are farthermost from the outlet end of the turbulence generator 10.

Figure 2 presents a turbulence generator 10 which is particularly appropriate for use in association with the web forming units starting with a Fourdrinier wire portion. The means comprises four superimposed rows R_1...R_4 of turbulence pipes $14b_1$...$14b_4$. The expansion spots 16 of the turbulence pipes are in this instance stepped to grow in that the space l_4 between the expansion 16 and the slice opening 13 in the turbulence pipes $14b_4$ of the lowermost pipe row R_4 is greatest and in the topmost pipe row R_1, the respective distance l_1 is smallest. The lowest layer of the stock suspension flow sprayed onto the Fourdrinier wire is filtered first and the topmost layer, last. To have the turbulence maintained longer in the upper stock suspension layer being dewatered last, the locations of the expansion 16 of the flow cross-section area are in the present embodiment stepped so that the expansions 16 in the lowermost pipe row R_4 closest to the level of the Fourdrinier wire are earlier in the flow direction and the pipe expansions 16 in the topmost pipe row R_1 farthermost from the Fourdrinier wire are last in the flow direction.

Figure 3 shows a turbulence generator for a gap former according to another embodiment of the invention. In this instance, the stepped expansion 16 located between the narrow initial part 15 of the turbulence pipe $14c_1$...$14c_4$ and the wide latter part 17 thereof is in all four superimposed rows R_1...R_4 of turbulence pipes in the flow direction at one and same distance from the slice opening 13 of the headbox. Instead, the superimposed turbulence pipes $14c_1$...$14c_4$ have different cross-sections so that the cross-section areas of the topmost and the lowermost turbulence pipes $14c_1$ and $14c_3$ are smaller than the cross-section areas of the two centremost turbulence pipes $14c_2$ and $14c_3$. The greater the cross-section of the flow duct, the greater in dimension is the turbulence generated in the pipe. A turbulence of a greater dimension also slows down more slowly than a turbulence of a smaller dimension.

A turbulence generator as in Figure 3 comprises further three trailing elements $20a_1...20a_3$ fastened as extensions to necks 18 separating the three superimposed pipe rows $R_1...R_4$ from each other, said elements extending to the slice cone 12 of the headbox. The purpose of the trailing elements $20a_1...20a_3$ is to keep the stock suspension flows of turbulence of different magnitude, coming from turbulence pipes $14c_1...14c_4$, apart from each other and in addition, to generate and/or to maintain the turbulence of the flow. In the design of the invention, said three trailing elements $20a_1...20a_3$ are different in length so that the topmost and the lowermost trailing elements $20a_1$ and $20a_3$ extend to the same distance $s_1 = s_3$ from the slice opening 13 of the headbox, and the middlemost trailing element $20a_2$ is shorter than the others, extending to distance s_2.

The turbulence generator in Figure 4 is intended for a Fourdrinier or hybride former. As in Figure 3, also in the present embodiment the cross-section areas of the turbulence pipes $14d_1...14d_3$ arranged in three superimposed rows $R_1...R_3$ are different so that the cross-section area in the lowermost pipe row $14d_3$ is smallest and the cross-section area in the topmost pipe row $14d_1$, and hence, also the dimension of the turbulence generated in the flow, is greatest. The lengths of two trailing elements $20b_1$ and $20b_2$ fastened as continuations to pipe rows $R_1...R_3$ are arranged so that the distance S_2 of the tip of the trailing element $20b_2$ from the slice opening 13 separating the two lowermost stock flows from each other is greater than the respective distance s_1 of the trailing element $20b_1$ separating the two topmost stock flows from each other.

Figure 5 presents a turbulence generator appropriate for a gap former, in which the technology of Figure 1 and Figure 3 is combined in an advantageous fashion. The expansion spots 16 in superimposed rows $R_1...R_5$ of turbulence pipes $14a_1...14a_5$ are so stepped that the centremost turbulence pipe $14a_3$ expands last in the flow direction and the two sidemost turbulence pipes $14a_1$ and $14a_5$ expand first in the flow direction. As extensions to the partitions 18 of the turbulence pipes $14a_1...14a_5$, four trailing elements $20c_1...20c_4$ are arranged, of which the

distance $s_2 = s_3$ of the tips of two centremost trailing elements $20c_2$ and $20c_3$ is smaller than the respective distance $s_1 = s_4$ of the two trailing elements $20c_1$ and $20c_4$ closer to the edge.

Also several other modifications of the invention are conceivable within the scope of the claims presented below. For instance, the trailing elements separating superimposed flows from each other can be mutually of identical dimensions when a layered turbulence has been generated in the stock suspension flow already in the preceding turbulence pipes.

Claims

1. A procedure for generating and maintaining turbulence in a stock suspension flow which is conducted through a turbulence generator (10) into a slice duct (12) of the headbox and therefrom, through a slice opening (13) to the web former, in which procedure the stock suspension flow is distributed into a number of superimposed layers with the aid of turbulence pipes ($14n_n$), wherafter an impact of elements (16,20) generating and maintaining turbulence is directed thereto, **characterized in** that turbulence is generated in different layers of the flow in different phases of the flow by arranging the elements (16, 20) generating and maintaining turbulence at different distances from the slice opening (13) of the headbox, whereby, at the slice opening (13), a different turbulence prevails in different layers of the stock suspension flow.

2. Procedure according to claim 1, **characterized in** that for elements generating and maintaining turbulence, stepped expansions (16) of the flow cross-section area of the turbulence pipes (14) are used, being positioned in superimposed rows (R_n) of the turbulence pipes ($14n_n$) at different distances (1_n) from the slice opening (13) of the headbox.

3. Procedure according to claim 1 or 2, **characterized in** that for elements generating and maintaining turbulence, trailing elements (20) on the outlet ends of the turbulence pipes ($14n_n$) are used, extending to the slice duct (12) of the headbox, the distance (s_n) of the tips whereof from the slice opening (13) of the headbox is arranged to be different between the superimposed flow layers.

4. Procedure according to any one of the preceding claims, **characterized in** that in the dimensioning of the elements (16,20) generating and maintaining turbulence, the structure of the web former subsequent to the headbox is taken into account in that in the layers of the stock suspension flow being dewatered last in the web former, said elements (16,20) are positioned closer to the slice opening

(13) of the headbox than in the layers of the stock suspension flow which will be filtered first.

5. A turbulence generator (10) for the headbox of a paper machine, comprising a number of superimposed turbulence pipes ($14a_n$; $14b_n$; $14c_n$; $14d_n$) arranged in rows (R_n) extending across the entire width of the headbox, through which a stock suspension flow to be conducted from the headbox to the web former is arranged to flow and which turbulence pipes (14_n) are provided with a stepped expansion (16) of the flow cross-section area in the space between the inlet end and the outlet end of the pipe, and to which turbulence generator (10), a plurality of trailing elements (20) may in addition be connected, starting from between the pipe rows (R_n) and extending to the slice duct (12) of the headbox, **characterized in** that in the superimposed pipe rows (R_n) the distance (l_n) of the expansion spot (16) of the turbulence pipes ($14a_n$; $14b_n$; $14c_n$; $14d_n$) from the slice opening (13) of the headbox and/or the distance (s_n) of the tips of the trailing elements (20) from the slice opening (13) of the headbox, in association with the pipe rows (R_n), is different so that at the slice opening (13) a different turbulence prevails in different layers of the stock suspension flow.

6. Turbulence generator according to claim 5, **characterized in** that in the superimposed rows (R_1...R_5) of turbulence pipes, the expansions (16) are the closer to the slice opening (13) of the headbox, the closer said pipe row is to the centremost pipe row (R_3) of the turbulence generator (10) (Figures 1 and 5).

7. Turbulence generator according to claim 5, **characterized in** that in the superimposed rows (R_1...R_5) of turbulence pipes, the expansions (16) are the closer to the slice opening (13) of the headbox, the farther said pipe row is from the lowermost pipe row (R_4) of the turbulence generator (10) (Figure 2).

8. Turbulence generator (10) according to claim 5, **characterized in** that the turbulence pipes ($14c_n$; $14d_n$) of superimposed pipe rows (R_n) have different flow

cross-section areas and the distance (s_n) of the tips of the trailing elements ($20a_n$; $20b_n$) from the slice opening (13) of the headbox, in association with the pipe rows (R_n), is different.

9. Turbulence generator according to claim 8, **characterized in** that the turbulence pipes ($14c_1$...$14c_4$) of the superimposed pipe rows (R_1...R_4) have the greater flow cross-section areas, the closer said pipe row (R_1...R_4) is to the centremost pipe row (R_2, R_3) of the turbulence generator (10) (Figure 3).

10. Turbulence generator according to claim 8, **characterized in** that the turbulence pipes ($14c_1$...$14c_3$) of the superimposed pipe rows (R_1...R_3) have the greater flow cross-section areas, the farther said pipe row (R_1...R_{23}) is from the lowermost pipe row (R_3) of the turbulence generator (10) (Figure 4).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 April 2001 (12.04.2001)

PCT

(10) International Publication Number
WO 01/25532 A1

(51) International Patent Classification?: D21F 1/02

(21) International Application Number: PCT/FI00/00843

(22) International Filing Date: 2 October 2000 (02.10.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
19992133 4 October 1999 (04.10.1999) FI

(71) Applicant *(for all designated States except US)*: METSO PAPER, INC. [FI/FI]; Fabianinkatu 9 A, FIN-00130 Helsinki (FI).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: SOINI, Sakari [FI/FI]; Kermisenkuja 5 C 16, FIN-31400 Somero (FI).

(74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).

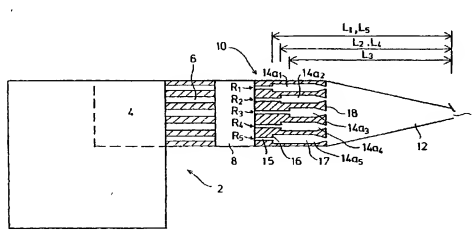
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: PROCEDURE AND MEANS FOR GENERATING TURBULENCE IN STOCK SUSPENSION FLOW



(57) Abstract: The present invention relates to a procedure for generating and maintaining turbulence in a stock suspension flow being conducted through a turbulence generator (10) into the slice duct (12) of the headbox and therefrom through a slice opening (13) to the web former. The invention also relates to the turbulence generator, comprising a number of superimposed turbulence pipes ($14a_n$) arranged in rows (R_n) extending across the entire width of the headbox. The stock suspension flow is with the aid of the turbulence pipes ($14a_n$) distributed into several superimposed layers, and the impact of the turbulence generating and maintaining elements (16) is directed thereto, for which elements the stepped expansion spots (16) of the flow cross-section area of a turbulence pipe (14) are used, and/or the trailing elements starting from between the pipe rows (R_n) and extending to the slice duct (12) of the headbox. In different layers of the flow, turbulence is generated in different phases of the flow by arranging said expansion spots (16) and/or the trailing elements in superimposed layers to be located at different distances from the slice opening (13) of the headbox, whereby a different turbulence prevails at the slice opening (13) in different layers of the stock suspension flow.

WO 01/25532 A1

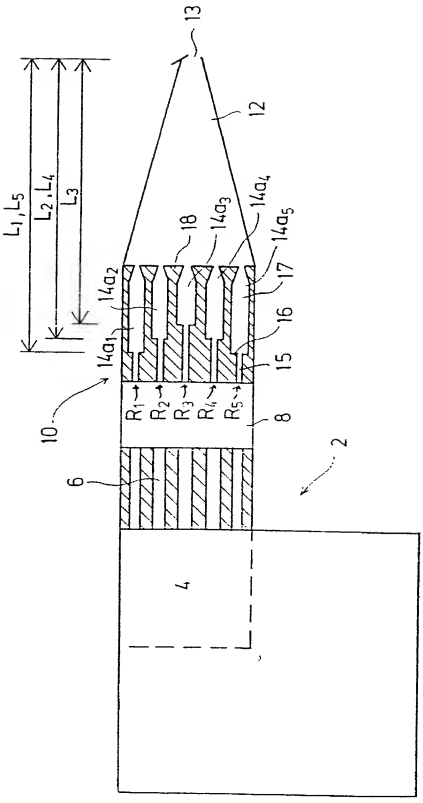

13
12
L1, L5
L2, L4
L3
18
14a3
14a4
14a5
14a2
17
16
14a1
15
10
R1
R2
R3
R4
R5
8
2
6
4

FIG. 1

WO 01/25532 PCT/FI00/00843

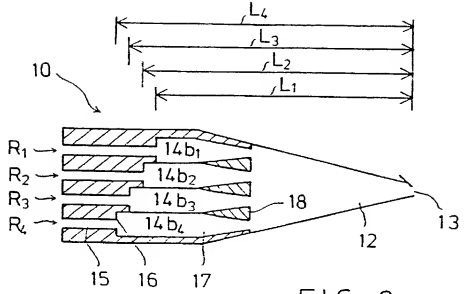


FIG. 2

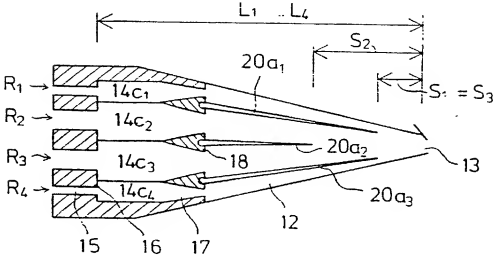


FIG. 3

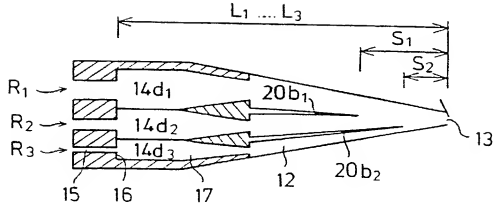

L1 ... L3
S1
S2
R1
R2
R3
14d1
14d2
14d3
20b1
20b2
13
15
16
17
12

FIG. 4

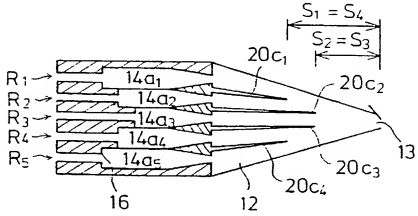

S1 = S4
S2 = S3
20c1
20c2
20c3
20c4
R1
R2
R3
R4
R5
14a1
14a2
14a3
14a4
14a5
13
16
12

FIG. 5

PTO/SB/01 (10-01)
Approved for use through 10/31/2002. OMB 0651-0032
U S Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	FORSAL-39
First Named Inventor	Sakari Soini
COMPLETE IF KNOWN	
Application Number	10/089,800
Filing Date	
Art Unit	
Examiner Name	

As the below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original and first inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Procedure and Means for Generating Turbulence in Stock Suspension Flow

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) October 2, 2000 as United States Application Number or PCT International Application Number PCT/FI00/00843 and was amended on (MM/DD/YYYY) April 3, 2002 (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
19992133	Finland	10/04/1999	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

10089800 .062402

PTO/SB/01 (10-01)
Approved for use through 10/31/2002. OMB 0651-0032
U.S Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

DECLARATION — Utility or Design Patent Application

Direct all correspondence to: [X] Customer Number or Bar Code Label 020,455 OR [ ] Correspondence address below

Name		
Address		
City	State	ZIP
Country	Telephone	Fax

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR : [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) Sakari		Family Name or Surname Soini	
Inventor's Signature Sakari Soini			Date 15,04,2002
Residence: ~~City Somero~~ FIX	State	Country Finland	Citizenship FI
Mailing Address Kermisenkuja 5 C 16			
City Somero	State	ZIP FIN-31400	Country Finland

NAME OF SECOND INVENTOR: [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])		Family Name or Surname	
Inventor's Signature			Date
Residence: City	State	Country Finland	Citizenship
Mailing Address			
City	State	ZIP	Country

[ ] Additional inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.